The switchgear shall be in accordance with the one-line diagram, and shall conform to the following specifications.

The switchgear shall consist of a gas-tight tank containing SF_6 gas, load-interrupter switches and re-settable fault interrupters with visible open gaps and integral visible grounds, and a microprocessor-based over current control.

Load-interrupter switch terminals shall be equipped with bushings rated 600 or 900 amperes continuous, and fault-interrupter terminals shall be equipped with bushing wells rated 200 amperes continuous or bushings rated 600 or 900 amperes continuous (as specified) to provide for elbow connection. Manual operating mechanisms and viewing windows shall be located on the **opposite side** of the tank from the bushings and bushing wells so that operating personnel shall not be required to perform any routine operations in close proximity to high-voltage elbows and cables.

Construction

SF_6 - Gas Insulation; the SF_6 gas shall conform to ASTM D2472. The switchgear shall be filled with SF_6 gas to a pressure of 7 psig at 68º F. The gas-tight tank shall be evacuated prior to filling with SF_6 gas to minimize moisture in the tank. The switchgear shall withstand system voltage at a gas pressure of 0 psig at 68º F. A gas-fill valve shall be provided. A temperature-compensated pressure gauge shall be provided that is color coded to show the operating range. The gauge shall be mounted inside the gas-tight tank (visible through a large viewing window) to provide consistent pressure readings regardless of the temperature or altitude at the installation site.

Gas-Tight Tank, The tank shall be submersible and able to withstand up to 10 feet of water over the base. The tank shall be of welded construction and shall be made of 7-gauge mild steel or Type 304 stainless steel, as specified in Section IV. A means of lifting the tank shall be provided.

Gas-Tight Tank Finish (for mild steel only) To remove oils and dirt, to form a chemically and anodically neutral conversion coating to improve the finish-to-metal bond, and to retard under film propagation of corrosion, mild-steel surfaces shall undergo a thorough pretreatment process comprised of a fully automated system of cleaning, rinsing, phosphatizing, sealing, drying, and cooling, before any protective coatings are applied. By utilizing an automated pretreatment process, the mild-steel surfaces of the gas-tight tank shall receive a highly consistent thorough treatment, eliminating fluctuations in reaction time, reaction temperature, and chemical concentrations. After pretreatment, protective coatings shall be applied that shall help resist corrosion and protect the mild-steel surfaces of the gas-tight tank. To establish the capability to resist corrosion and protect the mild steel, representative test specimens coated by the manufacturer's finishing system shall satisfactorily pass the following tests: 1500 hours of exposure to salt-spray testing per ASTM B 117 with: Under film corrosion not to extend more than ⅟ from the scribe as evaluated per ASTM D 1645, Procedure A, Method 2 (scraping); and (ii) Loss of adhesion from bare metal not to extend more than ⅟ from the scribe. 1000 hours of humidity testing per ASTM D 4585 using the Cleveland Condensing Type Humidity Cabinet with no blistering as evaluated per ASTM D 714. Crosshatch adhesion testing per ASTM D 3359 Method B with no loss of finish. Certified test abstracts substantiating the above capabilities shall be furnished upon request. The finish shall be inspected for scuffs and scratches. Blemishes shall be touched up by hand to restore the protective integrity of the finish. The finish shall be indoor light gray, satisfying the requirements of ANSI Standard Z55.1for No. 61.

Viewing Windows; Each load-interrupter switch shall be provided with a **large viewing window** at least **6 inches by 12 inches** to allow visual verification of the switch-blade position (open, closed, and grounded) while shining a flashlight on the blades. Each fault interrupter shall be provided with a large viewing window at least 6 inches by 12 inches to allow visual verification of the disconnect-blade position (open, closed, and grounded) while shining a flashlight on the blades. Viewing windows shall be located on the opposite side of the gear from the bushings and bushing wells so that

operating personnel shall not be required to perform any routine operations in close proximity to high-voltage elbows and cables. A cover shall be provided for each viewing window to prevent operating personnel from viewing the flash which may occur during switching operations.

High-Voltage Bus
Bus and interconnections shall withstand the stresses associated with short-circuit currents up through the maximum rating of the switchgear. Before installation of aluminum bus, all electrical contact surfaces shall first be prepared by machine abrading to remove any oxide film. Immediately after this operation, the electrical contact surfaces shall be coated with a uniform coating of an oxide inhibitor and sealant.

Provisions for Grounding
One ground-connection pad shall be provided on the gas-tight tank of the switchgear. The ground-connection pad shall be constructed of stainless steel and welded to the gas-tight tank, and shall have a short-circuit rating equal to that of the switchgear.

Terminations For gear rated 12.5-kA short circuit, terminals for load-interrupter switches shall have 600-ampere bushings, and terminals for fault interrupters shall have 200-ampere bushing wells. *For gear rated 25-kA short circuit,* terminals for load-interrupter switches and fault interrupters shall have 600- or 900-ampere bushings. **Bushings and bushing wells shall be located on one side of the gear to reduce the required operating clearance**. The following optional features should be specified as required: Bushings rated 600 or 900 amperes continuous shall be provided with out a threaded stud. For gear rated 12.5-kA only, the following optional features should be specified as required: Terminals for fault interrupters shall be equipped with 600- or 900-ampere bushings. Terminals for load-interrupter switches shall be equipped with 200-ampere bushing wells.

Bushings and Bushing Wells
Bushings and bushing wells shall conform to ANSI/IEEE Standard 386 (ANSI Standard C119.2). Bushings and bushing wells shall include a semi conductive coating. Bushings and bushing wells shall be mounted in such a way that the semi conductive coating is solidly grounded to the gas-tight tank.

Load-Interrupter Switches
The three-phase, gang-operated load-interrupter switches shall have a three-time and ten-time duty-cycle fault-closing rating as specified under “Ratings.” This rating defines the ability to close the switch the designated number of times against a three-phase fault with asymmetrical (peak) current in at least one phase equal to the rated value, with the switch remaining operable and able to carry and interrupt rated current. Certified test abstracts establishing such ratings shall be furnished upon request. The switch shall be provided with an integral ground position that is readily visible through the viewing window to eliminate the need for cable handling and exposure to high voltage to ground the equipment. The ground position shall have a three-time and ten-time duty-cycle fault-closing rating. The switch shall be provided with an open position that is readily visible through the viewing window to eliminate the need for cable handling and exposure to high voltage to establish a visible gap. The open gaps of the switch shall be sized to allow cable testing through a feed-thru bushing or the back of the elbow.

Fault Interrupters
Fault interrupters shall have a three-time and ten-time duty-cycle fault-closing and fault interrupting rating as specified under “Ratings.” This rating defines the fault interrupter’s ability to close the designated number of times against a three-phase fault with asymmetrical (peak) current in at least one phase equal to the rated value and clear the resulting fault current, with the interrupter remaining operable and able to carry and interrupt rated current. Certified test abstracts establishing such ratings shall be furnished upon request. The fault interrupter shall be provided with a disconnect with an integral ground position that is readily visible through the viewing window to eliminate the need for

cable handling and exposure to high voltage to ground the equipment. The ground position shall have a three-time and ten-time duty-cycle fault-closing rating. The disconnect shall be provided with an open position that is readily visible through the viewing window to eliminate the need for cable handling and exposure to high voltage to establish a visible gap. (e) The fault interrupter, including its three-position disconnect, shall be a single integrated design so that operation between the closed and open positions or the open and grounded positions is accomplished with a single, intuitive movement. The open gaps of the disconnect shall be sized to allow cable testing through a feed-thru bushing or the back of the elbow. An internal indicator shall be provided for each fault interrupter to show when it is in the tripped condition. The indicator shall be clearly visible through the viewing window.

Operating Mechanisms
Load-interrupter switches and fault interrupters shall be operated by means of a quick-make, quick-break mechanism. The manual handle shall charge the operating mechanism for opening, closing, and grounding of the switches and fault interrupters. (c) A single, integrated operating mechanism shall fully operate each fault interrupter or load interrupter switch in a continuous movement, so that additional operations are not required to establish open or ground positions. Operating mechanisms shall be equipped with an operation selector to prevent inadvertent operation from the closed position directly to the grounded position, or from the grounded position directly to the closed position. The operation selector shall require physical movement to the proper position to permit the next operation. Operating shafts shall be pad-lockable in any position to prevent operation. The operation selector shall be pad-lockable to prevent operation to the grounded position. The operating mechanism shall indicate switch position which shall be clearly visible from the normal operating position.

Over current Control
A microprocessor-based over current control shall be provided to initiate fault interruption.
The control shall be mounted in a watertight enclosure and shall be removable in the field without taking the gear out of service. Control settings shall be field programmable using a personal computer connected via a data port to the control. The data port shall be accessible from the exterior of the enclosure. Power and sensing for the control shall be supplied by integral current transformers.
The minimum total clearing time (from initiation of the fault to total clearing) for fault interruption shall be 40 milliseconds (2.4 cycles) at 60 hertz or 44 milliseconds (2.2 cycles) at 50 hertz.
The control shall feature time-current characteristic (TCC) curves including standard E-speed, K-speed, coordinating-speed tap, coordinating-speed main curves, and relay curves per IEEE C37.112-1996. Coordinating-speed tap curves shall optimize coordination with load-side weak-link/backup current-limiting fuse combinations, and coordinating-speed main curves shall optimize coordination with tap-interrupter curves. The standard E-speed curve shall have phase-over current settings ranging from 25E through 400E. The standard K-speed curve shall have phase-over current settings ranging from 25K through 200K. The coordinating-speed tap curve shall have phase-over current and independent ground-over current settings ranging from 50 amperes through 400 amperes. The coordinating-speed main curve shall have phase-over current and independent ground-over current settings ranging from 100 amperes through 800 amperes.

The time-over current relay curves conform to IEEE C37.112-1996 IEEE Standard Inverse-Time Characteristic Equations for Over current Relays for the following curves: U.S. Moderately Inverse Curve U1, U.S. Inverse Curve U2, U.S. Very Inverse Curve U3, U.S. Extremely Inverse Curve U4, U.S. Short-Time Inverse Curve U5, I.E.C. Class A Curve (Standard Inverse) C1, I.E.C. Class B Curve (Very Inverse) C2, I.E.C. Class C Curve (Extremely Inverse) C3, I.E.C. Long-Time Inverse Curve C4, and I.E.C. Short-Time Inverse Curve C5. The control shall have instantaneous-trip (1 kA through 8 kA) and definite-time delay (32 ms through 96 ms) settings to allow tailoring of the coordinating-speed tap and coordinating-speed main curves to the application.

Optional Voltage Indication

(Select voltage indication or voltage indication with provisions for low-voltage phasing.)

Voltage indication

Voltage indication for each load-interrupter switch and fault interrupter by means of capacitive taps on the bushings shall be provided to eliminate the need for cable handling and exposure to high voltage to test the cables for voltage. This feature shall include a flashing LCD display to indicate the presence of voltage for each phase, and a solar panel to supply power for testing of the complete voltage-indication circuit. The voltage-indication feature shall be mounted on the covers for the viewing windows on the opposite side of the gear from the bushings and bushing wells so that operating personnel shall not be required to perform any routine operations in close proximity to high-voltage elbows and cables.

Voltage indication with provisions for low-voltage phasing.

Voltage indication with provisions for low-voltage phasing for each load-interrupter switch and fault interrupter by means of capacitive taps on the bushings shall be provided to eliminate the need for cable handling and exposure to high voltage to test the cables for voltage and phasing. This feature shall include a flashing LCD display to indicate the presence of voltage for each phase, and a solar panel to supply power for testing of the complete voltage-indication circuit and phasing circuit. (2) The voltage-indication feature shall be mounted on the covers for the viewing windows on the opposite side of the gear from the bushings and bushing wells so that operating personnel shall not be required to perform any routine operations in close proximity to high-voltage elbows and cables.

Switchgear Style

(Pad-Mounted Style)To guard against corrosion due to extremely harsh environmental conditions, the gastight tank shall be made of Type 304 stainless steel.

Enclosure

The switchgear shall be provided with a pad-mounted enclosure suitable for installation of the gear on a concrete pad. The pad-mounted enclosure shall be separable from the switchgear to allow clear access to the bushings and bushing wells for cable termination. The basic material shall be 14-gauge hot-rolled, pickled, and oiled steel sheet. The enclosure shall be provided with removable front and back panels, and hinged lift-up roof sections for access to the operating and termination compartments. Each roof section shall have a retainer to hold it in the open position. Lift-up roof sections shall overlap the panels and shall have provisions for padlocking that incorporate a means to protect the padlock shackle from tampering. The base shall consist of continuous 90-degree flanges, turned inward and welded at the corners, for bolting to the concrete pad. Panel openings shall have 90-degree flanges, facing outward, that shall provide strength and rigidity as well as deep overlapping between panels and panel openings to guard against water entry. For bushings rated 600 amperes continuous, the termination compartment shall be of an adequate depth to accommodate encapsulated surge arresters mounted on 600-ampere elbows having 200-ampere interfaces. For bushing wells rated 200 amperes continuous, the termination compartment shall be of an adequate depth to accommodate 200-ampere elbows mounted on feed-thru inserts. An instruction manual holder shall be provided. Non-removable lifting tabs shall be provided.

Enclosure Finish

All exterior welded seams shall be filled and sanded smooth for neat appearance. To remove oils and dirt, to form a chemically and anodically neutral conversion coating to improve the finish-to-metal bond, and to retard under film propagation of corrosion, all surfaces shall undergo a thorough pretreatment process comprised of a fully automated system of cleaning, rinsing, phosphatizing, sealing, drying, and cooling, before any protective coatings are applied. By utilizing an automated pretreatment process, the enclosure shall receive a highly consistent thorough treatment, eliminating fluctuations in reaction time, reaction temperature, and chemical concentrations. After pretreatment, protective coatings shall be applied that shall help resist corrosion and protect the steel enclosure. To

establish the capability to resist corrosion and protect the enclosure, representative test specimens coated by the manufacturer's finishing system shall satisfactorily pass the following tests:
4000 hours of exposure to salt-spray testing per ASTM B 117 with:
(a) Underfilm corrosion not to extend more than **1/3**2" from the scribe as evaluated per ASTM D 1645, Procedure A, Method 2 (scraping); and
(b) Loss of adhesion from bare metal not to extend more than **1/8"** from the scribe.
(c) 1000 hours of humidity testing per ASTM D 4585 using the Cleveland Condensing Type Humidity Cabinet with no blistering as evaluated per ASTM D 714.
(d) 500 hours of accelerated weathering testing per ASTM G 53 using lamp UVB-313 with no chalking as evaluated per ASTM D 659, and no more than 10% reduction of gloss as evaluated per ASTM D 523.
(e) Crosshatch adhesion testing per ASTM D 3359 Method B with no loss of finish.
(f) 160-inch-pound impact adhesion testing per ASTM D 2794 with no chipping or cracking.
(g) Oil resistance testing consisting of a 72-hour immersion bath in mineral oil with no shift in color, no streaking, no blistering, and no loss of hardness.
(h) 3000 cycles of abrasion testing per ASTM 4060 with no penetration to the substrate. Certified test abstracts substantiating the above capabilities shall be furnished upon request.
The finish shall be inspected for scuffs and scratches. Blemishes shall be touched up by hand to restore the protective integrity of the finish. The finish shall be olive green, Munsell 7GY3.29/1.5.
The finish shall be outdoor light gray, satisfying the requirements of ANSI Standard Z55.1 for No. 70.

Labeling

Hazard-Alerting Signs

The exterior of the pad-mounted enclosure shall be provided with "Warning—Keep Out—Hazardous Voltage Inside—Can Shock, Burn, or Cause Death" signs. (b) Each unit of switchgear shall be provided with a "Danger—Hazardous Voltage—Failure to Follow These Instructions Will Likely Cause Shock, Burns, or Death" sign. The text shall further indicate that operating personnel must know and obey the employer's work rules, know the hazards involved, and use proper protective equipment and tools to work on this equipment. (c) Each unit of switchgear shall be provided with a "Danger—Keep Away—Hazardous Voltage—Will Shock, Burn, or Cause Death" sign.

Nameplates, Ratings Labels, and Connection Diagrams

Each unit of switchgear shall be provided with a nameplate indicating the manufacturer's name, catalog number, model number, date of manufacture, and serial number. (b) Each unit of switchgear shall be provided with a ratings label indicating the following: voltage rating; main bus continuous rating; short-circuit rating; fault-interrupter ratings including interrupting and duty-cycle fault-closing; and load-interrupter switch ratings including duty-cycle fault-closing and short-time.